

## AGRICULTURAL DIVERSIFICATION IN NORTH EASTERN REGION OF INDIA

**LALRINSANGPUII<sup>1</sup> & R. MALHOTRA<sup>2</sup>**

<sup>1</sup>*Research Scholar, Division of Dairy Economics, Statistics & Management,*

*National Dairy Research Institute, Karnal, Haryana, India*

<sup>2</sup>*Principal Scientist, Division of Dairy Economics, Statistics & Management,*

*National Dairy Research Institute, Karnal, Haryana, India*

### ABSTRACT

*This study, based on the secondary data collected from various sources, attempts to find out the contribution of different crops on overall growth of crop sector and the pattern and determinants of agricultural diversification in North Eastern Region of India. Compound annual growth rates and Simpson Diversity Index (SID) were used to estimate the diversification. During the past few years cereals had registered negative growth in terms of area and production whereas spices, vegetables, pulses and fruits had registered positive growth indicating the movement towards diversity. The region had moved towards greater diversification during the past years as the value SID had increased from 0.48 in 2004-05 to 0.61 in 2014-15. Also the growth of livestock and its products has been increasing over the years. The share of NER annual milk production had declined from 75.71 % in the year 2004-05 to 71.26 % 2014-15 but the reverse trend was found in case of meat and fish. On an average, 24 % of the area was allocated to vegetables and 2.2 % to fruits. To speed-up the process of agricultural diversification, government need to take series of reform measures to integrate production and markets efficiently.*

**KEYWORDS:** Growth rates, Diversification, Crop, Livestock

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### INTRODUCTION

The North Eastern Region (NER) of India is a region as interesting and varied as India itself. The economy of the region continues to be predominantly agrarian, even though the agriculture base remains weak. A large number of people inhabiting the hills continue to follow the traditional practice of *jhum* (shifting cultivation). Farmers grow only one crop in a year and farming is basically at a subsistence level. Agricultural surpluses remain meagre and are borne out by the near absence of local rice and paddy sold in the markets. Self-sufficiency in food grains, thus, remains an unattainable goal. The region (except Sikkim) imported 2.4 million tonnes of food grains in 2005 through the Food Corporation of India (Birthal 2010). This results in the draining away of the region's financial resources, overload the transportation network and results in leakage of most of the benefits of investment made in the region. About 85 % of the region's population is rural, and a majority of it depends on agriculture and allied activities, directly or indirectly, the agricultural sector engaged 58 % of the region's total workforce. The sector is dominated by small landholders – more than three-fourths of the land holdings in the NER are less than or equal to 2 ha in size (Mohammad Rais *et al.* 2014).

The diversification of agriculture towards selective high value cash crops including fruits and off-season vegetables, compatible with the comparative advantage of the region, is suggested as a viable solution to stabilize and raise farm income, increase employment opportunities, and conserve and enhance the natural resources,

principally land and water (Vyas 1996). Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. It is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk.

The adoption of high value cash crops particularly fruit crops, helps the mountainous regions in two ways: first, it promotes the productive use of abundant marginal lands available in these regions. Second, these crops help in maintaining and improving the ecology and environment by promoting soil conservation and improving soil fertility. In economic terms, it leads to significant improvement in the quality of life of the people. The NER has a congenial agro-climatic environment favouring cultivation of a variety of seasonal and off-season vegetables, fruits, flowers, spices, and aromatic and ornamental plants (Asati and Yadav 2004; Nakro and Khiki 2006). Thus, the region has the potential to leapfrog from the existing subsistence agriculture to a commercial one through agricultural diversification. But, the congenial environment could not be utilized to harness the huge untapped potential due to a number of operational constraints.

## DATA AND METHODOLOGY

The study covers a period of 20 years (1994-95 to 2014-15) for judging the annual compound growth rates and 10 years (2004-05 to 2014-15) for estimating the percentage share of various crops in total area and the pattern of diversification. The secondary data for the study were collected from different published and unpublished sources viz., Basic Statistics of NER, State's Agriculture and Animal Husbandry Departments, National Horticulture Board, etc.

Diversification can be defined as a movement of resources from one agri-enterprise to another or a larger mix of enterprises considering their likely risks returns leading to a production portfolio that minimizes risks and increases income (Joshi *et al.* 2004). It can also be considered as a shift of resources from farm and non-farm activities or simply a larger mix of diverse and complementary activities within agriculture. In this paper, diversification is treated as a shift resources from low-value staples to high-value enterprises (crops), and measure it as the share of crop 'i' in the gross cropped area and/or value of output of agriculture.

There are quite a few measures of diversification; important ones include Herfindal Index, Simpson Diversity Index, Ogive Index and Entropy Index. To estimate the diversification status the Compound annual growth trends, Simpson Diversity Index (SID) were applied in this study.

### Compound Growth Rates

The compound growth rates was computed to understand the pace and pattern of agricultural development. To estimate the compound growth rate following formula was used:

$$\log Y = a + \beta t$$

$$\text{Growth rate} = (\exp(\beta) - 1) * 100$$

Where,

$Y$	=	Area, production, productivity
$a$	=	Intercept
$t$	=	Time
$\beta$	=	Slope coefficient

### Diversification Estimation

The nature and patterns of diversification can be examined by looking into temporal changes in area, production of different crops. The contribution of different crops to overall growth in crop sector is estimated as the sum of annual changes in area of crop 'i' (from year t to t+1) divided by the sum of changes in area of all crops.

$$S_i = \frac{\sum_{t=1}^T \Delta \text{Area}_{it}}{\sum_{t=1}^T \sum_{i=1}^n \Delta \text{Area}_{it}}$$

Where,

$S_i$	=	The share of crop 'i' in the overall growth of crop sector
$\Delta \text{Area}$	=	Change in area of crop 'i' ( $i=1$ to $n$ ) from year t to t+1 ( $t=1$ to $T$ )

To estimate the speed of diversification in favour of high value commodities, annual compound growth rates of area and production of different crop/livestock activities are calculated. Simpson Index of Diversification (SID) provides a clear dispersion of commodities in a geographical region. The index ranges between 0 and 1. In case of complete specialization, the index moves towards 0.

$$\text{SID} = 1 - \sum_{i=1}^n p_i^2$$

Where,

$\text{SID}$	=	The Simpson Index of Diversity
$p_i$	=	The proportionate area of $i^{\text{th}}$ crop in the gross cropped area

### RESULTS AND DISCUSSIONS

Agriculture and allied activities account for over a quarter of region's GDP, and their share has been declining. Among the states, the share of agriculture in GDP in the year 2008-09 was lowest in Mizoram (14 %) and highest in Nagaland (29 %), except in Nagaland where it had declined considerably since the early 1990s. The performance of agricultural sector in the region had been quite impressive during the past one decade or so (Table 1). At the regional level, the sector grew at an annual rate of 3.1 %, slightly higher than the national level of 2.8 %. In Manipur, Meghalaya, Nagaland and Tripura its performance was better than the national average.

**Table 1: Per Cent Share of Agriculture in GDP and Annual Growth Rate in North-Eastern States (1993-94 to 2008-09) (Per Cent)**

States	Share of agriculture in GDP		Annual growth rate, 1993-94 to 2008-09	
	1993-94	2008-09	Agricultural GDP	GDP
Arunachal Pradesh	43.4	25.8	1.25	5.34
Assam	39.4	27.9	2.48	6.29
Manipur	35.5	23.6	3.30	5.80
Meghalaya	25.3	19.5	4.82	7.35
Mizoram	29.6	13.9	0.58	6.19
Nagaland	24.4	28.5	9.21	6.43
Sikkim	34.3	17.0	2.63	7.78
Tripura	35.3	22.4	4.84	8.67
Northeast	36.8	25.9	3.12	6.55

**Source:** National Accounts Statistics (various years)

With a share of 69 % in the gross value of output of the agricultural sector, crops comprise the most important segment. The shares of crops, however, vary considerably within the region; 55 to 60 % in Manipur, Mizoram and Nagaland, 65 to 70 % in Arunachal Pradesh, Assam, Meghalaya and Tripura, and 85 % in Sikkim (National Accounts Statistics, 2008-09). Consistent with the overall pattern of structural changes associated with the process of economic development, the contribution of agriculture to the Net State Domestic Product (NSDP) declined continuously. The sector contributed 26 % to the northeastern region's NSDP in 2008-09, down by 11 % points than in 1993-94.

Table 2 shows that the primary sector, including crops, animal husbandry, fisheries and forestry, mining and quarrying during the period 2004-05 and 2010-11 plummeted from 27 % to 20 %. Consequently, contribution of secondary and tertiary sectors increased respectively from 22 % and 51 % in 2004-05 to 25 and 59 % in 2010-11. During the period, the Net State Domestic Product (NSDP) increased progressively and the per capita NSDP in the region in 2010-11 was ` 35077 (2004-05 prices).

**Table 2: Sectoral Distribution of Net State Domestic Product (NSDP) in NER of India: 2004-05 to 2010-11 (Per Cent)**

SI/No.	Sectors	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
1.	Primary sector	27	27	25	25	23	21	20
2.	Secondary sector	22	23	21	23	23	24	24
3.	Tertiary sector	51	50	54	52	54	55	56
4.	All sectors	100	100	100	100	100	100	100
5.	Net State Domestic Product (NSDP) at 2004-05 prices (Rs. in Crores)	78320	82026	86390	91009	97967	106449	114550
6.	Per capita NSDP (Rs.)	24039	25316	26380	27835	30139	33012	35077

**Source:** National Accounts Statistics (various years)

#### Compound Annual Growth Rates

To judge the performance of crop sector in NER, the compound annual growth rates in case of area, production and yield of major crops was worked out by dividing the period into two *i.e.*, from 1994-95 to 2004-05 and 2005-06 to 2014-15. Cereals had registered negative growth in the past years whereas spices, vegetables, pulses and fruits had registered positive growth in case of acreage and total production which is a clear indication of moving towards diversity (Table 3). The maximum increase in area occurred in case of fruits (5.15 %). Among the crops the production of vegetables and fruits recorded higher growth rates in the second period (2005-06 to 2014-15) than the first period (1994-95 to 2004-05). Further, the growth rates of production in all the crops except fruits and vegetables were lower in the second period compared with the first period. The growth rate of yield was highest in case of vegetables (7.39 %), followed by spices, pulses and fruits. Further the growth rates of yield for all the crops except spices were higher in second period compared to first period.

**Table 3: Compound Annual Growth Rates of Area, Production and Yield of Various Crops**

Crops	CAGR (Area)		CAGR (Production)		CAGR (Yield)	
	1994-95 to 2004-2005	2005-06 to 2014-15	1994-95 to 2004-2005	2005-06 to 2014-15	1994-95 to 2004-2005	2005-06 to 2014-15
Rice	0.38	-0.17	1.15	0.99	0.75	1.18
Maize	3.36	1.56	3.67	1.51	0.24	-0.35
Wheat	1.63	-4.75	1.08	-5.98	-0.48	-0.90
Cereals	-0.99	-0.51	-1.12	-0.50	-0.18	0.02
Pulses	19.78	1.86	17.39	3.31	-0.22	1.35
Potato	3.12	1.62	6.30	0.38	3.11	-1.11
Vegetables	4.57	1.79	5.40	9.30	0.65	7.39
Turmeric	2.76	3.16	10.22	1.71	7.12	-1.41
Ginger	10.21	3.89	10.31	4.65	0.06	0.72
Chillies	2.69	1.39	7.20	-1.62	4.39	-3.03
Spices	2.17	2.79	7.26	4.65	4.99	1.93
Fruits	2.98	5.15	1.75	6.22	-1.01	1.05

**Source:** Calculated from various sources

Still, cereals occupies major share of total cultivable land in North-Eastern Region, but a silent revolution is witnessed in case of fruit crops, spices, and vegetables due to high domestic and export demand.

#### Share of Different Crops with SID

Cereals was the major crops grown in North-East India with a share of 58.81 % of total cropped area of the region during the year 2014-15 which is a clear decline from 70.57 % during the year 2004-05 (Table 4). Next to cereals vegetables occupy second highest share in total cropped area of the region. The share of vegetables had been increasing over the years from 6.93 % in the year 2004-05 to 11.98 % in 2014-15 but the share of oilseeds had been constant over the period (8 %). Increasing trend can also be observed in case of other crops *i.e.*, pulses, spices and fruits but the increasing rate of pulses was almost negligible. Acreage under spices had increased during the year 2014-15 (7.51 %) in comparison to 2004-05 (4.41 %). The acreage share of fruits had also increased from 6.21 per cent to 9.80 per cent during the year 2004-05 to 2014-15. Over the years the values of SID had increased from 0.48 in 2004-05 to 0.61 in 2014-15 which implies presence of diversification. The region had moved towards greater diversification during the past years as the value SID had increased over the years.

**Table 4: Percent Share of Different Crops in Total Area and SID in Different Year**

Years	Cereals	Pulses	Vegetables	Spices	Fruits	Oilseeds	Total	SID
2004-05	70.57	3.42	6.93	4.41	6.21	8.46	100	0.48
2005-06	70.77	3.44	9.95	4.49	6.43	7.92	100	0.50
2006-07	67.00	3.61	8.69	4.55	7.67	8.48	100	0.55
2007-08	67.39	3.79	8.53	4.69	7.37	8.23	100	0.54
2008-09	69.29	3.68	7.64	4.58	6.60	8.21	100	0.57
2009-10	68.30	3.70	8.07	4.70	7.07	8.16	100	0.55
2010-11	66.07	3.89	8.45	5.06	7.92	8.61	100	0.56
2011-12	61.58	3.46	10.88	6.58	8.57	8.83	100	0.59
2012-13	61.53	3.11	11.27	6.89	8.82	8.38	100	0.59
2013-14	59.97	3.37	11.94	7.37	8.84	8.51	100	0.60
2014-15	58.81	3.47	11.98	7.51	9.80	8.43	100	0.61

**Source:** Calculated from various sources

### Share of Livestock Sector in NER

Although cereals dominate the cropping pattern in this region, livestock are an important component of mixed farming system and dependence on livestock as an alternative source of income is significant. Further, because of social and religious acceptance, the consumption of meat is relatively higher in this region, and that of milk and milk products is lower. Coupled with the traditional meat-eating habit, increasing per capita income, urbanization and changes in life-style, the region is deficit in production of livestock products. Some states in the region depend on inter-state trade in livestock to meet the domestic demand. However, responding to the burgeoning demand for livestock products in a sustainable manner is a big challenge.

**Table 5: Compound Annual Growth Rates of Livestock and its Products**

Period	Livestock	Milk	Meat	Egg	Fish
2004-05 to 2014-15	2.52	1.73	6.99	2.39	3.41

**Source:** Calculated from various sources

Table 5 shows that the growth of livestock and its products had been increasing over the period (2004-05 to 2014-15). The highest growth rate was found on meat (6.99 %), followed by fish (3.41 %), egg (2.39 %) and milk (1.73 %). In absolute terms, milk production had increased in all NE states, except Manipur.

The share of NER annual milk production was 75.71 % in the year 2004-05 which declined to 71.26 % in 2014-15 (Table 6). The per capita milk availability had declined at the aggregate level in NER and it was well below the recommended level of per capita milk consumption of 220 g/day. But the reverse trend was found in case of meat and fish. The percentage share of meat and fish had been increasing over the period from 8.43 and 15.87 % in 2004-05 to 11.79 and 16.95 % in 2014-15.

**Table 6: Percentage Share of Livestock Product during 2004-05 to 2014-15**

Years	Milk	Meat	Fish	Total
2004-05	75.71	8.43	15.87	100
2005-06	75.93	8.43	15.64	100
2006-07	75.98	8.55	15.46	100
2007-08	76.06	8.49	15.45	100
2008-09	73.57	10.98	15.45	100
2009-10	72.79	11.9	15.32	100
2010-11	72.92	11.21	15.87	100
2011-12	73.03	10.23	16.74	100
2012-13	70.99	12.58	16.43	100
2013-14	70.28	12.46	17.25	100
2014-15	71.26	11.79	16.95	100

**Source:** Calculated from various sources

### Farm Size and Diversification

The farmers' participation in fruits and vegetables production was examined in terms of the proportion of the household growing these crops and their area share. Table 7 shows that on an average 70.9 % of the households in the NER had grown vegetables and 5 % had grown fruits. The participation rate in vegetable production increased with farm size and highest participation rate was found on semi-medium farms (76.1%). However, the participation rate in the fruit production was the lowest among the large farmers, followed by small farmers.

Table 7 also presents the share of fruits and vegetables in total cropped area by farm size for the growing households. In general, farmers allocate a relatively small proportion of their land to vegetables and fruits comparing to cereals. On an average, 24 % of the area was allocated to vegetables and 2.2 % to fruits. The pattern of area allocation to fruits did not differ much across farm categories, which ranged between 2 and 2.4 %. For vegetables, the relationship with farm size was distinctly negative. On marginal farms, vegetables occupy over 33.2 % of the area compared to 19.8 % on large farms.

**Table 7: Percent Household and Area under Fruits and Vegetables in the Year 2010-11 (per cent)**

Crop	Marginal	Small	Semi-medium	Medium	Large	All Categories
Household growing fruits and vegetables						
Vegetables	62.3	65.5	76.1	75.9	74.5	70.9
Fruits	5	4.5	6.2	6.1	4.3	5
Area under fruits and vegetables						
Vegetables	33.2	24.8	22.3	20.1	19.8	24.0
Fruits	2.1	2.3	2.0	2.4	2.1	2.2
Cereals	54.5	62.3	65.1	63.4	60.7	61.2
Pulses	4.3	3.9	2.9	3.1	2.9	3.4
Others	5.9	6.7	7.7	11.0	14.5	9.2
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: GOI, 2012

These results clearly show that small holders do participate in high-value agriculture and allocate a larger proportion of area to high value crops especially vegetables. This is expected, as most vegetables have a short production cycle and generate quick returns. Besides, small holders have sufficient endowment of labour to cultivate labour-intensive crops like vegetables. The cultivation of fruits is also labour-intensive, but its initial capital requirement is higher, and gestation period is longer that discourage farmers to undertake cultivation of such crops.

## CONCLUSIONS

The results of the study show that agricultural sector of NER is gradually diversifying towards high value commodities, namely fruits, vegetables and spices. However, the speed of diversification is rather slow and is much less than that of the country as a whole. Still a silent revolution is taking place and area coverage of fruits, vegetables and spices has increased substantially during the last few years. The higher returns from the high value crops therefore supports commercialization and diversification of small farms within and outside agriculture and their proper integration with local and global markets. This is intended not only to liberate the small and marginal farmers from the poverty trap, but also to meet the country's growing demands for fruits, vegetables, which generally show rising trends with increasing levels of per-capita income in the economy.

For sustainable progress of agricultural diversification in the region, government has to take series of reform measures to integrate production and markets, efficiently. In the era of public-private partnership farm-firm linkages, such as contract farming, cooperatives and group actions may be right endeavor in this direction. These initiatives have the ability to augment farm income of small holders through aversion of risk and uncertainty and establishing strong vertical linkage between production, marketing and processing.

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